

A revision of the *Cardamine paucijuga* complex (Brassicaceae)

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ABSTRACT

Four new species *Cardamine lineariloba* I. Thomps., *Cardamine microthrix* I. Thomps., *Cardamine papillata* I. Thomps. and *Cardamine moirensis* I. Thomps. are described and illustrated. *Cardamine paucijuga* is contrasted with the new species.

Introduction

Cardamine L. is a genus of about 200 species in the family Brassicaceae. The majority of species occur in temperate regions of northern and southern hemispheres. In Australia, a small number of endemic species are currently recognised, the majority of which are confined to south-eastern Australia, including Tasmania. They occur in moist habitats which include lowland swamps or watercourses, forests, sub-alpine woodlands and a variety of alpine habitats. Species described in this paper mostly occur at lower altitudes. Several introduced species in Australia are similar to, and can occupy similar habitats to, the native species although more commonly they occur in urban environments.

Cardamine paucijuga was described by Turczaninov in 1854 based on a Western Australian specimen collected in 1848 by Drummond. This name was subsequently not recognised in Australian floras until resurrected by Hewson (1982). She included all native *Cardamine* from south-east Australia and Tasmania with petals less than 4 mm long in this species. Before this time, these taxa were identified as either *C. hirsuta* L. or *C. parviflora* L., two northern hemisphere species. Hewson described *C. paucijuga* as an annual, tap-rooted species, glabrous or sometimes hairy (but not with long, straight hairs like the introduced *C. hirsuta* and *C. flexuosa* With.) and with petals 2.5–3.5 mm long. Examination of herbarium specimens and evidence from field work and growth trials indicates the existence of four entities separable from *C. paucijuga* on the basis of foliar, stem, floral and inflorescence characters.

Taxonomy

Cardamine papillata I. Thomps., *sp. nov.*

Cardamini paucijugae Turcz. affinis, habitu humiliore, caulibus foliaceis minus, foliis caulium minoribus dissectis, racemis primariis brevioribus et floribus paucioribus, caulibus et pedicellis papillatis plerumque, stylo brevioribus plerumque differt.

HOLOTYPE: Victoria, Maramingo Creek area, c. 4 km direct NE of Genoa P.O. 26 Dec. 1969, A.C. Beaglehole 32819 (MEL).

Small annual to ?perennial herb, to 25 cm high, glabrous or papillate. *Tap-rooted*. *Stems* erect to ascending, slender, glabrous, sometimes minutely papillose, often branching from the base and from cauline leaf axils. *Leaves* thin; basal leaves long-petiolate, simple or pinnate with 1–2 pairs of lateral pinnae and a much larger terminal pinna, to 7 cm long, forming a persistent rosette; terminal pinna entire, orbicular, slightly cuneate or more often shallowly cordate at the base; lateral leaflets orbicular, short-stalked or sessile; cauline leaves 0–3, variable in shape, sometimes with papillose margins, the lowermost sometimes similar to basal leaves, simple or with 1–2 pinna pairs, otherwise

much reduced in length, usually less than 2 cm, and dissection, pinnate or pinnatifid and sessile. *Inflorescences* 1-10(-15) flowered racemes, often very few-flowered. *Sepals* ovate, green or purple-pigmented, 1.5-2.5 mm long, petals slender, cuneate to spatulate, 3-4.5 mm long, all white or pink on the outside; stamens 6; stigma subsessile or mature style up to c. 1 mm long. *Siliques* erect to sub-erect, linear, 20-35 mm long, c. 1 mm wide, pedicels erecto-patent, 5-15 mm long, sometimes minutely papillose. *Seeds* elliptic, 1.0-1.2 mm long. (Fig. 1)

DISTRIBUTION AND CONSERVATION STATUS

Cardamine papillata has a scattered distribution in hilly to mountainous regions of South Australia, Victoria, New South Wales and Tasmania. In South Australia it is confined to hills east of Adelaide and southward down the Fleurieu peninsula. In New South Wales it has a somewhat disjunct distribution though this is possibly due to it being a small and inconspicuous species that is not commonly collected with its actual distribution being more continuous along the Great Dividing Range. Although not common it does not appear to be threatened. (Fig. 2)

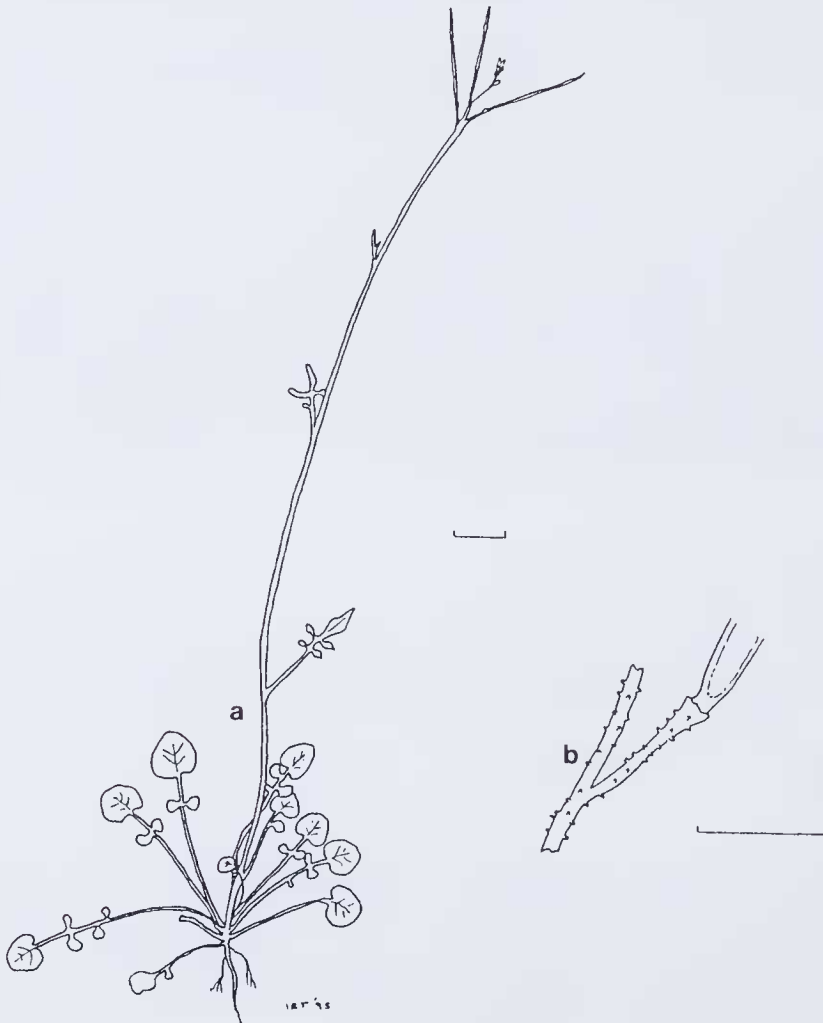


Fig. 1. *Cardamine papillata*. a - habit, b - pedicel and stem with papillae. From *Beauglehole* 32819 (MEL).

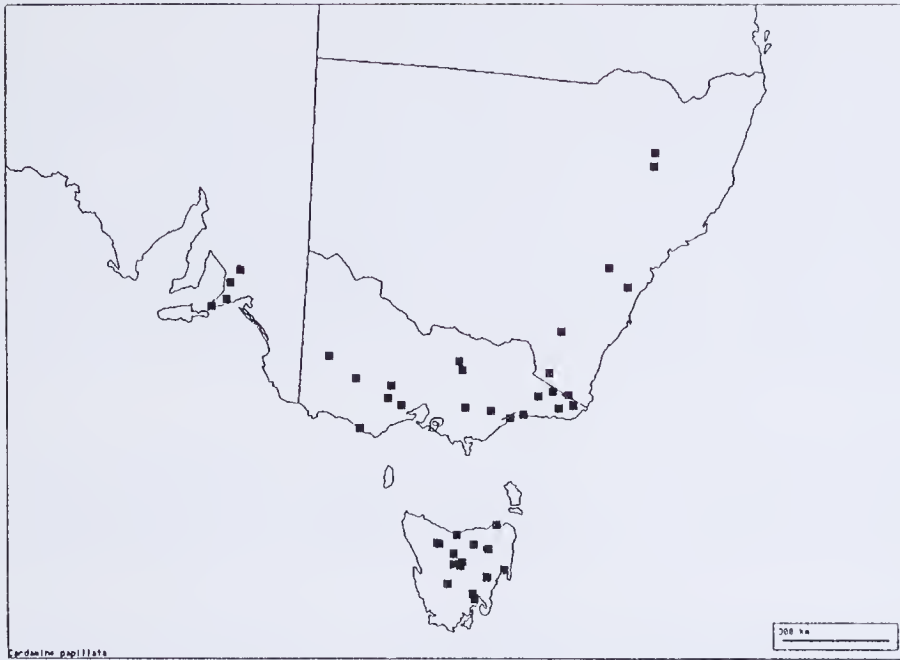


Fig. 2. Distribution of *Cardamine papillata*.

HABITAT

Cardamine papillata occurs most commonly in hilly, forested areas at lower altitudes, but has also been recorded from near coastal localities. It prefers moist, shaded areas often in rocky sites near streams and growing amongst mosses. Plants in these habitats are often tiny and produce primary racemes of only 1-3 flowers.

ETYMOLOGY

The specific epithet of the new species refers to the small papillae that often develop on the stems, pedicels and leaf margins of this species.

REPRESENTATIVE SPECIMENS (80 specimens examined)

SOUTH AUSTRALIA: Hindmarsh Tiers, Southern Lofty, 28 Aug. 1965, *J.B. Cleland* (AD).

VICTORIA: Bentley Plains road, 18 Feb. 1971 *A.C. Beauglehole* 36799 (MEL); Little Hard Hills area east of Hall's road, Enfield Forest Park, 24 km SSW of Ballarat P.O., 23 Oct. 1978, *A.C. Beauglehole* 61009 (MEL); Gippsland Lakes Coastal Park, SE of Rotamah Island 9 Sep. 1987, *I. Crawford* 633 (MEL); Briagolong State Forest, 28 Sep. 1984, *A.C. Beauglehole* 77461 (MEL); Port Campbell National Park between Crown of Thorns and the Grotto, 29 Oct. 1966, *A.C. Beauglehole* 21519 and *E.W. Finck* (MEL); Daylesford, 1880, *Wallace* (MEL).

NEW SOUTH WALES: Near Back (or Stony) creek, 0.5 km NW of Ramshead creek, 1981, *S.J. Forbes* 662 (MEL); Attunga State Forest, 620 m., 27 Oct. 1990, *J.R. Hosking* 186 (NSW); Warrabah National Park, 450 m., 9 Sep. 1987, *J.R. Hosking* (NSW); Beside Nimmitabel-Bega Rd., Glenbog State Forest, Southern Tablelands, 10 Dec. 1970, *A.N. Rodd* 1577 (NSW).

TASMANIA: Clarke Is., 1893, *J.H. Maclaine* (MEL); Saltwater Lagoon, Friendly Beaches, 30 Dec. 1983, *A.M. Buchanan* 2158 (HO); Florentine Valley, 12 Dec. 1952, *W.M. Curtis* (HO); Allwrights Lagoons, 5 km NNE of Waddamana, 882 m, 1 Dec 1990, *A. Moscal* 20282 (HO).

Cardamine lineariloba I. Thomps. *sp. nov.*

Cardamine paucijugae Turcz. affinis, foliis simplicibus, linearibus ad spatulatos anguste, vel dissectis lobis lateralibus linearibus directis prorsum, lobo terminale longiore multo, racemis primariis brevioribus et floribus paucioribus, stylo brevioribus plerumque differt.

HOLOTYPE: Victoria, Mt Arapiles SE slope along watercourse c. 1 mile [1.6 km] down from top, 22 Sep. 1968, *A.C. Beaglehole 28699* (MEL).

Small, annual herb, glabrous, to 25 cm high. Fibrous rooted with slender tap-root sometimes persisting. *Stems* slender, erect to ascending, usually much branched from the base and from cauline leaf axils. *Leaves* thin; basal leaves simple, to 6 cm long, persisting early in flowering; often entire, narrow oblanceolate the base very attenuate, occasionally shallowly lobed distally, sometimes pinnatisect with 1-several sessile linear lateral lobes angled forward and with a much longer almost linear terminal lobe, lobes entire, 0.3-2 cm long; cauline leaves mostly several, initial flowering stem often naked, similar to basal leaves, gradually reducing in size up the stem. *Inflorescences* mostly few-flowered racemes. *Sepals* green, ovate, 1.5-2 mm long; petals cuneate, 3-5 mm long, white, stamens 6; stigma sub-sessile or mature style up to 1mm long. *Siliques* erect, linear, 9-20 mm long, c. 1 mm wide on erecto-patent pedicels 5-10 mm long. *Seeds* elliptic. c. 1.2 mm long. (Fig. 3)

DISTRIBUTION AND ECOLOGY

Cardamine lineariloba occurs in Victoria and South Australia extending from near Lake Terangpom in the south-west of Victoria north-westwards to the Little Desert region of Victoria and westwards to an area between Mt. Gambier and Naracoorte in South Australia. Not often collected. Its conservation status is uncertain. (Fig. 4)

HABITAT

Cardamine lineariloba occurs in lowland areas along stream banks and in seasonally wet lowland environments such as swamp margins.

ETYMOLOGY

The specific epithet of the new species refers to its leaf morphology.

REPRESENTATIVE SPECIMENS (23 specimens examined)

SOUTH AUSTRALIA: Bugle Range, 1848, *F. Mueller* (MEL); 5 km SW of Tarpeena (AD); 150 m S of enclosure, Calceatasia Conservation Park, 29 Oct. 1986, *P. Gibbons 586* (AD).

VICTORIA: Between Lake Gnarpurt and Lake Terangpom, 24 km NE of Camperdown P.O., 7 Oct. 1977, *G.J. Hirth* (MEL); Saline flats near Mt William, Sept 1879, *D. Sullivan 31* (MEL); 3 km S of Dadswell

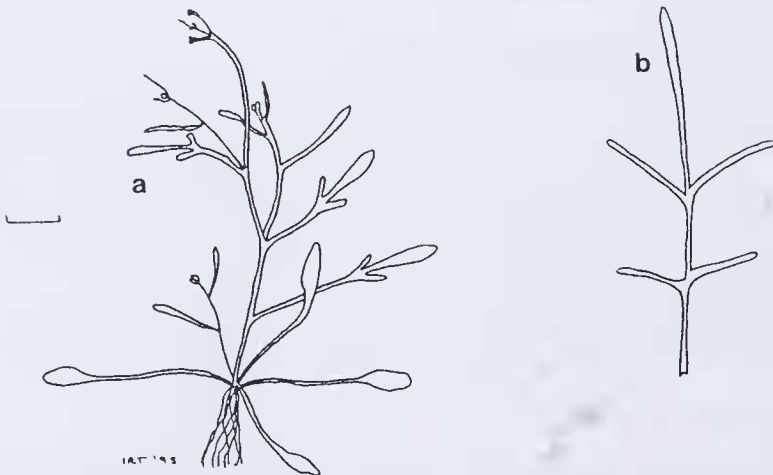


Fig. 3. *Cardamine lineariloba*. a — habit, b — leaf variant. a — from *Beaglehole 74495* (MEL), b — from *Beaglehole 28699* (MEL).

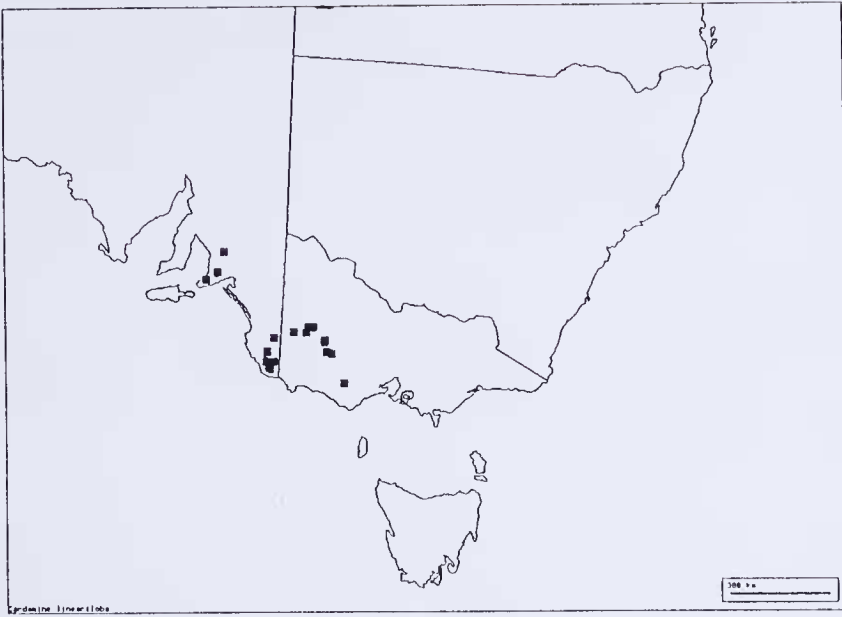


Fig. 4. Distribution of *Cardamine lineariloba*.

Bridge, Grampians National Park, 30 Aug. 1983, *A.C. Beauglehole* 74495 (MEL); c. 4 km NE of Goroke P.O., Goroke State Forest, 4 Sep. 1986, *A.C. Beauglehole* 83709 (MEL); Roadside adjacent to Darlot Swamp, NE of Horsham, 2 Sep. 1995, *I.R. Thompson* 96 (MEL).

Cardamine microthrix* I. Thomps., *sp. nov.

Cardamini paucijugae Turcz. affinis, robustiori, erecta, caulibus pilosis interdum, pinnis foliorum caulium margine ciliatis sparse, pinna terminali latiore, 3-9-lobata differt.

HOLOTYPE: Victoria, Clarke Lagoon Wildlife Reserve, north-east study area, 28 Oct. 1987, *A.C. Beauglehole* 89710 and *L.W. Huebner* (MEL).

Annual herb, to 30 cm high. *Tap-root* slender to stout. *Stems* slender to robust, usually erect, glabrous to sparsely hairy, branching from the base and from cauline leaf axils. *Leaves* thin; basal leaves long petiolate, mostly pinnate, to 8 cm long, with 1-2 pinna pairs, forming a rosette, somewhat persistent; terminal pinna large, broadly ovate with a cordate base; lateral pinnae ovate, petiolulate; margins of pinnae entire, crenate or shallowly lobed; cauline leaves usually 2 or more, usually well-developed, pinnate with 1-2(-3) pairs of lateral pinnae; terminal pinna often broad, ovate, (3-)5-9 lobed, often deeply and acutely; lateral pinnae ovate, petiolulate, usually trilobed; few to many minute cilia on margins of some to all pinnae of cauline leaves. *Inflorescences* few to many-flowered racemes, commonly 8 or more per raceme. *Sepals* green, ovate, c. 1.5 mm long; petals cuneate c. 3 mm long, white; stamens 6; style 0.5 to 1 mm long. *Siliquas* sub-erect to erect, sometimes crossing over the rachis, 20-30 mm long, c. 1 mm wide on sub-erect pedicels 5-10 mm long. *Seeds* elliptic c. 1.2 mm long. (Fig. 5)

DISTRIBUTION AND CONSERVATION STATUS

Cardamine microthrix occurs in eastern Victoria and NSW in higher rainfall areas between the Great Dividing Range and the coast and has a disjunct distribution in South Australia. In Victoria it is found in central to east Gippsland and in the far north-east of the state. In New South Wales it appears to be more widespread and has a scattered distribution from the far north to the far south of the state and its northerly distribution suggests that it is likely to occur in at least the far south of Queensland. In South Australia it is restricted to hilly country to the east and south of Adelaide with an older record from Wellington near the mouth of the Murray. Its widespread distribution indicates that it is not threatened. (Fig. 6)

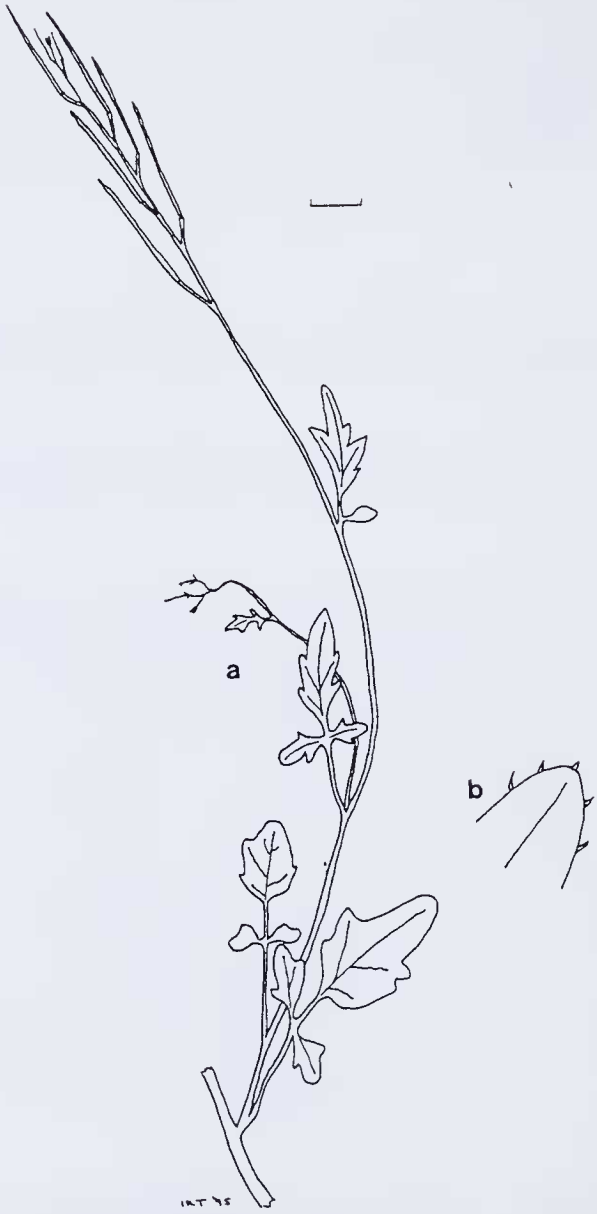


Fig. 5. *Cardamine microthrix*. a - habit. b - leaf margin x2. a-b from *Wilson* (MEL).

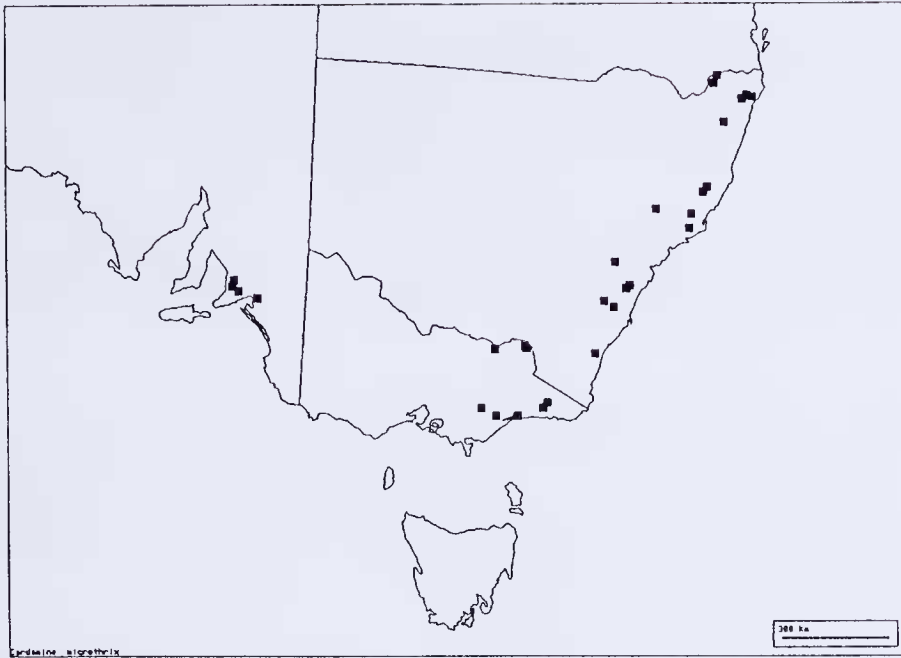


Fig. 6. Distribution of *Cardamine microthrix*.

HABITAT

Cardamine microthrix occurs along river, stream and lagoon banks and adjacent low-lying areas.

ETYMOLOGY

The specific epithet of the new species refers to the minute cilia present on pinna margins. This character is not present in other native species of *Cardamine*.

REPRESENTATIVE SPECIMENS (specimens examined)

SOUTH AUSTRALIA: Kaiser Stuhl, 1848, *F. Mueller* (MEL); Clarendon, 1882, *Tepper 697* (MEL); Manning Reserve, 30 km S of Adelaide, 24 Mar. 1971, *A.G. Spooner 1216* (AD).

VICTORIA: East Gippsland, Ellery Forest Block, Ferntree Creek near Sardine Creek road, 7 Jan. 1987, *G.E. Earl 388* (MEL); Colquhoun Regional Park, 29 Oct. 1984, *A.C. Beauglehole 79076* and *J.R. Turner and J.G. Eichler* (MEL); Perry River Bridge area, 18 km ESE of Stratford P.O., 6 May 1985, *A.C. Beauglehole 79632* and *J.R. Turner* (MEL); Cobberas National Park, 27 Oct. 1987, *A.C. Beauglehole 89511* and *L.W. Huebner* (MEL).

NEW SOUTH WALES: Jembaicumbene Ck. 10 km SW of Braidwood, Alt. 660 m, 20 Oct. 1991, *B.J. Lepschi 598* (SYD, CANB, HO); Richmond River, 1876, *Fawcett*, (MEL); Tilba Tilba, 1881, *Miss Mary Bate 113*, (MEL); Devlin's Creek in Pennant Hills Park, Cheltenham, 2 Nov. 1982, *R.G. Coveny 11328* (MEL); Nepean River, Merangle, 13 Jan. 1968, *E.J. McBarron 14839* (NSW); Below Marshall Falls, 1 mile (1.6 km) S of Alstonville, North Coast, 25 Oct. 1961, *E.F. Constable* (NSW); Wollondilly River, S of Gibraltar Rock, 6 km N of Marulan, 30 Oct. 1977, *L.A.S. Johnson 8384* (NSW); Sandy Creek, Bulahdelah-Booral Rd., north coast, 28 Sep. 1973, *A.N. Rodd 2353* (NSW).

Cardamine moirensis I. Thomps., *sp. nov.*

Cardamini paucijugae Turcz. affinis, pinna terminali foliorum basalium truncata ad cuneatam basi, foliis pinnis plus habentibus, pinnis lateralibus lobatis saepe, racemo primario brevior et floribus paucioribus, stylo brevior plerumque differt.

TYPUS: Victoria, eastern end of reserve on Ulupna Island, 10 km NW of Strathmerton in the Murray Valley, 35°51', 145°26', 20 Sep. 1978, *T.B. Muir 5965* (HOLOTYPUS: MEL; ISOTYPUS: NSW, HO, AD, CANB).

Small annual herb, to 30 cm high, glabrous. *Tap-root* slender to stout. *Stems* slender, erect to ascending, branching from the base and from cauline leaf axils, sometimes reddish at maturity. *Leaves* thin; basal leaves long-petiolate, to 8 cm long, pinnate with 1-4 pinna pairs, forming a few-leaved non-persistent rosette; terminal pinna ovate, trilobed, truncate to cuneate based, lateral pinnae entire or often with one or two lateral teeth, elliptic to narrow obovate; cauline leaves usually 3 or more, similar to basal leaves but shorter and with pinnae narrowing, becoming narrowly obovate to filiform and entire towards the summit. *Inflorescences* few-flowered racemes, mostly 2-8 flowered. *Sepals* green, ovate, 1.5-2 mm long; petals cuneate, 2-3.5 mm long, white; stamens 6, stigma sub-sessile or mature style to 1 mm long. *Siliquas* linear, 15-30 mm long, c. 1.0 mm wide, usually sub-erect on erecto-patent pedicels 5-15 mm long. *Seeds* elliptic, 1.0-1.2 mm long. (Fig. 7)

DISTRIBUTION AND CONSERVATION STATUS

Cardamine moirensis has been recorded mostly from the Riverina region in northern Victoria and southern NSW, between Rutherglen and Kerang, but also from an area in far western Victoria adjacent to the Little Desert and from Hattah-Kulkyne National Park (Murray Mallee). In NSW it has been recorded from Henty, Balranald and Mathoura. Although not protected in any National Parks, it does not appear to be immediately threatened assuming there are no major disturbances to the watercourses and swamps where it occurs. (Fig. 8)

HABITAT

Cardamine moirensis forms sparse to dense colonies in low-lying areas adjacent to streams and swamps. In northern Victoria it is commonly associated with *Eucalyptus camaldulensis* and *Rorippa laciniata*.

ETYMOLOGY

The specific epithet of the new species refers to the County of Moira (also now the Shire of Moira) which is the region in northern Victoria where it has most frequently been collected and which is approximately at the centre of its distribution in the Riverina region.

REPRESENTATIVE SPECIMENS (40 specimens examined)

NEW SOUTH WALES: Balranald, 1878, *Dr Lucas* (MEL); Dudal Comer Swamp, SW of Henty, 18 Oct. 1971, *B.G. Briggs 4390 and L.A.S. Johnson* (NSW).

VICTORIA: Black Swamp Wildlife Reserve, 25 Sep. 1985, *A.C. Beaglehole 80917* (MEL); Two Mile Swamp Wildlife Reserve, 6 Sep. 1985, *A.C. Beaglehole 80111* (MEL); Lake Moodemere Reserve, 25 Sep. 1985, *A.C. Beaglehole 80957* (MEL); Loch Garry Wildlife Management Co-operative Area, 11 Sep. 1985, *A.C. Beaglehole 80317* (MEL); Yarriambiack Creek, County of Borung, 8 Oct. 1903, *F.M. Reader* (MEL); Ulupna Island Reserve in Murray Valley, 3 miles NW of Strathmerton, 7 Oct. 1969, *T.B. Muir 4706* (MEL); Far North West, Hattah Lakes National Park lake area, 21 Oct 1969, *G.W. Anderson* (MEL); Roadside adjacent to Darlot Swamp, NE of Horsham, 2 Sep. 1995, *I.R. Thompson 97* (MEL).

NOTES

The type specimen of *C. paucijuga* was collected from the Swan River in south-west Western Australia in 1848 (Drummond 131). In 1867, *Cardamine* specimens differing from the type were collected from Warren River and Porongorup also in the south-west of the state. To my knowledge, there have been no further records of native *Cardamine* from WA since 1867. The type specimen consists of two sheets showing ten separate flowering and/or fruiting stems but information about basal leaf and root morphology is lacking. Thus, it has proved difficult to assign eastern Australian *Cardamine* to this species with certainty. Although specimens from Victoria, New South Wales and Tasmania similar to the type of *C. paucijuga* (Fig. 9), but differing from the new species described above, are for now still assigned to *C. paucijuga*, they are somewhat polymorphic and some of the forms may not be *C. paucijuga sensu stricto*. Indeed, unless more information is forthcoming regarding the nature of the Western Australian entities it may be wiser not to continue to include these remaining eastern Australian entities in *C.*

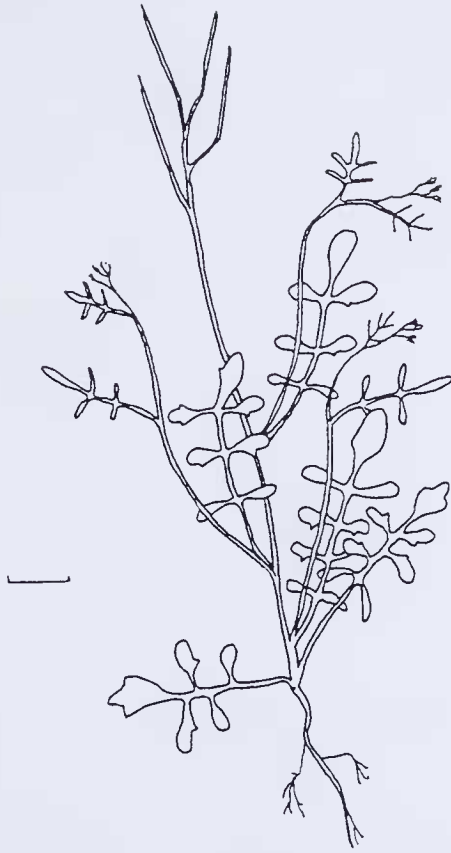


Fig. 7. *Cardamine moirensis*. a — habit. From *Beaglehole 64513* (MEL).

paucijuga. These forms occur in southern Victoria, north-east Victoria and from several localities in New South Wales and Tasmania (Fig 10).

Leaf morphology is the most important factor in distinguishing the four new species. In particular, leaves of *C. lineariloba* and *C. microthrix* are distinctive. The leafiness of stems, the tendency of cauline leaves to reduce in size and dissection up the stem and the tendency of basal leaves to persist is also important, especially in distinguishing *C. papillata* from the other species. The presence of papillae in *C. papillata* and hairs on the stem and pinna margins in *C. microthrix* are also important characters. *C. paucijuga* tends to have laxer stems and racemes than the other species and pressed specimens of *C. paucijuga* often have more collapsed and shrivelled stems suggesting that its stems are more tender.

Cardamine moirensis differs from other species by having leaves with more pairs of lateral pinnae and pinnae that are more frequently lobed or dentate (except compared to *C. microthrix*). Eastern Australian forms that remain in *C. paucijuga* have at least some basal leaves with a terminal pinna that is cordate at the base, whereas the terminal pinna of basal leaves of *C. moirensis* is never cordate. *Cardamine lineariloba*,

C. moirensis and *C. papillata* commonly have a very few-flowered (1-8) primary raceme, whereas *C. paucijuga* and *C. microthrix* commonly have primary racemes with 8 or more flowers. It is important to note that secondary racemes and racemes of depauperate specimens tend to be fewer-flowered and so will not be as useful in

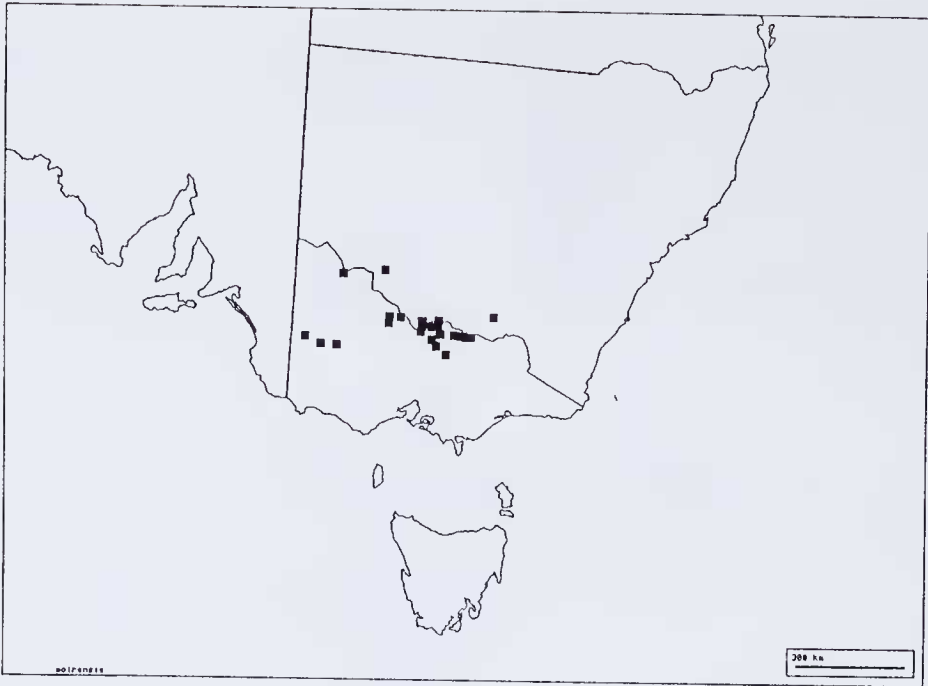


Fig. 8. Distribution of *Cardamine moirensis*.

distinguishing these species. Tasmanian specimens identified as *Cardamine* sp. aff. *corymbosa*, by Hewson (1982) are considered to be merely depauperate forms of *C. papillata*.

Cardamine lineariloba and *C. moirensis* appear to be true annuals whereas the capacity of the other three species to persist into a second season is uncertain. *Cardamine papillata* is able to persist into a second season when grown as a pot plant and there is evidence from pressed specimens that *C. paucijuga* can also persist.

Cardamine lineariloba and *C. moirensis* occur in lowland areas that are seasonally flooded or wet and are largely geographically separated from the other small-flowered native species. At several localities in the Wimmera (Western Victoria) they occur together. *Cardamine papillata*, *C. microthrix* and *C. paucijuga* occur in more elevated or near coastal sites.

Plants matching specimens from Taiwan, labelled as *C. flexuosa*, in MEL and AD occur in most capital cities of Australia. This form resembles typical *C. flexuosa* but is sufficiently different to warrant taxonomic recognition (see key below under *C. aff. flexuosa*). At this point I have been unable to determine if this has already occurred. It is mentioned here because it has often been misidentified as *C. paucijuga* in Australia. It occurs predominantly (?only) in urban areas or areas close to human habitation and therefore is presumed to be introduced. It has been recorded at numerous sites in the inner Melbourne area especially in municipal garden beds and in plant nurseries. It has also been recorded from nurseries in Canberra, Perth and Sydney, and from near Coffs Harbour. *Cardamine hirsuta* has also been misidentified as *C. paucijuga*. Presumably this has occurred because the sparsely hairy leaves of *C. hirsuta* can appear glabrous unless closely examined. The following key includes these and two other species in Australia with similar flower sizes that could be confused with the native species described above.

KEY TO *CARDAMINE PAUCIJUGA* AND ALLIES

The leaf blade of simple leaves is referred to here as the terminal pinna. The term pinna refers both to leaflets of pinnate leaves and to lobes of pinnatisect leaves when



Fig. 9. *Cardamine paucijuga*. Habit., from Drummond 131 (G).

they resemble leaflets (i.e. if they are narrower towards the base).
 All of these species produce secondary inflorescences on flowering stems arising from the base of the primary stem or from cauline leaf axils. These inflorescences are often fewer flowered than the primary inflorescence. In this key, the number of flowers per raceme refers to the primary inflorescence. Depauperate specimens will have fewer flowers per raceme than is usual for that species.

- 1: Leaves and/or stems with simple hairs (sometimes requires close inspection).....2
- 1: Leaves and stems glabrous or minutely papillose.....6

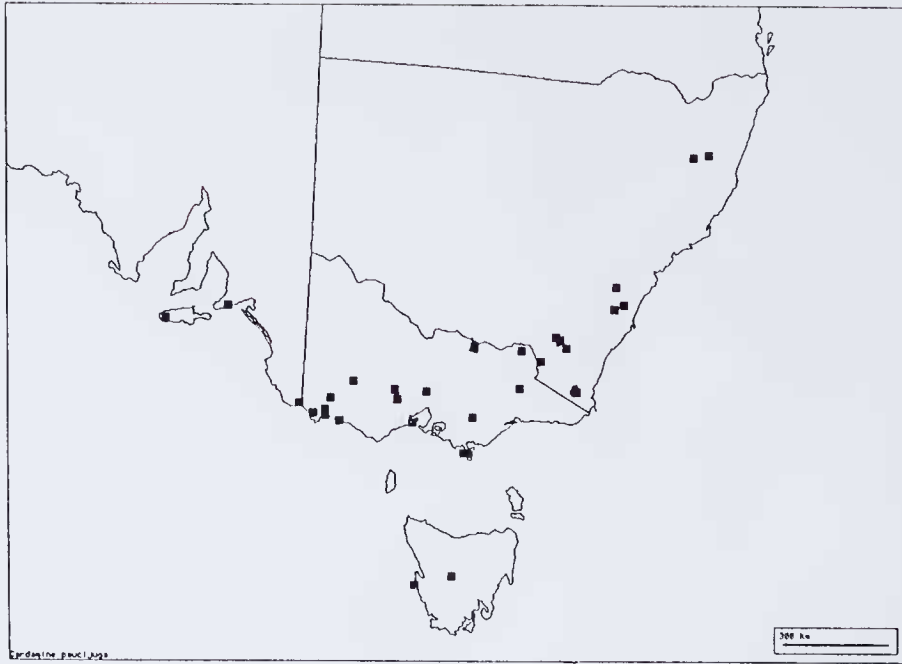


Fig. 10. Distribution of *Cardamine paucijuga*.

- 2 Upper surface of leaves glabrous (pinna margins may be sparsely hairy) 3
- 2: Upper surface of leaves with scattered hairs 4
- 3 Fruits sub-erect, inclined at less than 45° to rachis, terminal pinna of cauline leaves 3-9 lobed, basal leaves forming a rosette, seeds greater than 1.0 mm long, stems usually green and glabrous *Cardamine microthrix*
- 3: Fruits spreading to c. 60° to rachis, terminal pinna of cauline leaves entire to trilobed, basal leaves few, seeds less than 1.0 mm long, base of stems often reddish-purple and pubescent (weed of gardens and nurseries) **Cardamine aff. flexuosa*
- 4 Leaves mostly with 0-2 pairs of lateral pinnae, flowering stems not held erect, often not developed, pedicels commonly arising in whorls of 3 or 4, sometimes appearing to arise singly from the base, siliquas less than 1 mm wide, flowers often apetalous or with less than 4 petals (weed of gardens, two collections, from Melbourne and Hobart) **Cardamine corymbosa*
- 4: Leaves with 1-6 pairs of lateral pinnae, main flowering stem erect, pedicels alternating along rachis, fruits 1-1.5 mm wide, flowers usually 4 petalled 5
- 5 Stems glabrous to very sparsely hairy, stamens mostly 4, fruits glabrous or hairy, sub-erect, inclined at less than 45° to rachis and usually clearly overtopping open flowers in the same inflorescence, inflorescence rachis straight, cauline leaves 0-3, rarely more, leaf surface not obviously tuberculate **Cardamine hirsuta*
- 5: Stems sparsely to densely hairy, stamens mostly 6, siliquas glabrous and spreading, inclined at greater than 45° to rachis and not or hardly overtopping open flowers of the same inflorescence, inflorescence rachis often flexuose, cauline leaves 2 or more, leaf surface often tuberculate due to tubercle-based hairs *Cardamine flexuosa*
- 6 Seeds 0.8-1.0 mm long, basal leaves few, usually shorter than cauline leaves and not persisting, racemes many-flowered with siliquas erecto-patent to spreading,

- inclined at 45-90° to rachis, flower buds often with several hairs (weed of gardens and nurseries) **Cardamine aff. flexuosa*
- 6: Seeds 1.0-1.3 mm long or more, plants not combining the above features (native species) 7
- 7 Basal and cauline leaves simple and linear to narrowly spatulate, or often pinnatisect with one to several short to long linear lobes projecting forwards from one or both sides of an otherwise narrow linear lamina, annual plant with few-flowered racemes *Cardamine lineariloba*
- 7: At least some leaves not as above 8
- 8 Terminal pinna of cauline leaves 3 or more lobed or toothed, lateral pinnae usually also lobed or toothed, most pinnae with several minute cilia on margins *Cardamine microthrix*
- 8: Terminal and lateral pinnae of cauline leaves entire or with one or two lateral lobes or teeth, pinnae not minutely ciliate on margins (but may be papillate) 9
- 9 Cauline leaves 0-3, size and dissection reducing markedly with successive leaves, lateral pinnae of basal and sometimes lower cauline leaves orbicular to elliptic, entire, basal rosette of leaves commonly persisting *Cardamine papillata*
- 9: Cauline leaves usually 2 or more, all pinnate to deeply pinnatisect with overall leaf shape and size changing only gradually with successive leaves, lateral pinnae of basal and cauline leaves elliptic to narrow obovate, entire or with one or two lateral teeth, basal leaves usually not persisting 10
- 10 Petals 2-3.5 mm long, white, terminal pinna of basal leaves usually distinctly trilobed, the base truncate to cuneate, mature style usually less than 1.0 mm long, at least some pinnae of cauline leaves lobed, inflorescences mostly 2-8 flowered, stems and pedicels of pressed specimens not markedly shrivelled *Cardamine moirensis*
- 10: Petals 3-6 mm long, white or pink, terminal pinna of basal leaves not trilobed, the base of at least some cordate, mature style up to 2.0 mm long, pinnae of cauline leaves all or mostly entire, inflorescences often more than 8 flowered, stems and pedicels of pressed specimens often collapsed and shrivelled *Cardamine paucijuga*

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